

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: CHAD RUE, ET AL.)
Serial No.: 10/711,691) Group Art Unit: 2881
Filed: September 30, 2004)
For: APPARATUS AND METHOD FOR) Examiner: Yantorno, J.
MANIPULATING SAMPLE)
TEMPERATURE FOR FOCUSED ION) Confirmation No.: 5690
BEAM PROCESSING)

AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In response to the Office Action mailed March 17, 2006, please amend the Application as follows:

AMENDMENTS TO THE CLAIMS

1. (original) An apparatus for manipulating the temperature of a sample used in focused ion beam FIB processing, comprising:
 - a base member;
 - a thermoelectric module disposed over the base member; and
 - a sample mounted on a mounting surface of the thermoelectric module;

wherein said thermoelectric module is configured so as to reduce the temperature of said sample with respect to an ambient FIB tool temperature.
2. (original) The apparatus of claim 1, wherein said thermoelectric module further comprises a Peltier device.
3. (original) The apparatus of claim 2, wherein said thermoelectric module is configured to draw heat from the sample and exhaust said heat through said base member.
4. (currently amended) The apparatus of claim 1, wherein said thermoelectric module is electrically coupled to a current source through an electrical connector disposed through a vacuum chamber wall of an FIB tool and into an interior vacuum section of the FIB tool.
5. (original) The apparatus of claim 1, further comprising a thermal ballast module mounted on said base member.
6. (original) The apparatus of claim 5, wherein said thermal ballast module is disposed adjacent to said thermoelectric module.
7. (previously presented) The apparatus of claim 5, wherein said thermoelectric module is mounted on said thermal ballast module.

8. (original) The apparatus of claim 5, wherein said thermal ballast module further comprises:

a sealed, hollow vessel constructed from a material having a high thermal conductivity; and

a plurality of internal fins configured for facilitating heat transfer from said base member to an internal ballast material, said internal ballast material including a high heat-capacity material.

9. (original) The apparatus of claim 4, further comprising a plurality of cooling ports within said base member, said cooling ports for receiving a cooling medium circulated therethrough supplied by a cooling supply line.

10. (original) The apparatus of claim 9, wherein said cooling supply line is coupled to a cooling medium connector disposed through a vacuum chamber wall of an FIB tool.

11. (currently amended) A method for implementing focused ion beam (FIB) processing, the method comprising:

mounting a sample on a mounting surface of thermoelectric element included within an FIB tool, said mounting surface including a thermoelectric element;

controlling said thermoelectric element so as to reduce the temperature of said sample with respect to an ambient FIB tool temperature; and

applying an FIB to said sample.

12. (original) The method of claim 11, wherein said thermoelectric element further comprises a Peltier device.

13. (original) The method of claim 11, further comprising utilizing said FIB

to deposit a layer on said sample.

14. (original) The method of claim 13, wherein said layer comprises an insulating layer deposited using a silicon-bearing precursor.

15. (original) The method of claim 14, wherein said insulating layer comprises SiO₂.

16. (previously presented) The method of claim 13, wherein said layer comprises an insulating layer deposited using at least one or more of the following precursor combinations: tetramethylcyclotetrasiloxane (TMCTS) with no oxidizing agent, tetraethylorthosilicate (TEOS) with O₂, TMCTS with H₂O, TMCTS with O₂, TEOS with O₂, TEOS with H₂O.

17. (original) The method of claim 13, wherein said layer comprises a metal layer deposited using at least one or more of the following precursor combinations: tungsten hexacarbonyl (W(CO)₆), methylcyclopentadienyl (trimethyl) platinum (V), any of the beta-diketonate copper (II) complexes, and any of the Lewis-base copper (I) beta-diketonate complexes.

18. (original) The method of claim 11, further comprising utilizing said FIB in a removal process to remove material from said sample.

19. (original) The method of claim 18, wherein said removal process further comprises at least one of: milling silicon using a xenon difluoride (XeF₂) precursor, milling SiO₂ using an XeF₂ precursor, milling tungsten using an XeF₂ precursor, milling SiCOH type low-k dielectric materials using an XeF₂ precursor, milling chromium using an XeF₂ precursor, milling organic materials and polymers using an XeF₂ precursor, milling copper using an XeF₂ precursor, milling silicon using a Br₂ precursor, and milling

aluminum using a Br₂ precursor.

REMARKS

Reconsideration of the instant application is respectfully requested. The present amendment is responsive to the Office Action of March 17, 2006, in which claims 1-19 are presently pending. Of those, claims 1, 11, 13 and 18 have been rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent 6,751,516 to Richardson. Claims 2 and 12 are rejected under 35 U.S.C. §103(a) as being unpatentable over Richardson, in view of U.S. Patent 5,708,371 to Koyama. Claims 3-7 are rejected under 35 U.S.C. §103(a) as being unpatentable over Richardson, in view of Koyama, and further in view of U.S. Patent 4,555,626 to Suzuki. In addition, claims 8-10 have also been rejected under 35 U.S.C. §103(a) as being unpatentable over Richardson, in view of Koyama and Suzuki, and further in view of U.S. Patent Publication 2002/0162339 of Harrison, et al.

Claims 14-16 are rejected under 35 U.S.C. §103(a) as being unpatentable over Richardson, in view of Koyama and Suzuki, and further in view of U.S. Patent 6,372,627 to Ring, et al. Finally, claims 17 and 19 are rejected under 35 U.S.C. §103(a) as being unpatentable over Richardson, in view of Koyama and Suzuki, and further in view of U.S. Patent 6,863,787 to Huynh, et al. For the following reasons, however, it is respectfully submitted that the application is now in condition for allowance.

Claim 11 has been amended to more specifically define the relationship between the sample and the thermoelectric element associated with the FIB tool. Claim 1 as originally filed already recites the structural relationship between the base member, the thermoelectric module and the sample. That is, the thermoelectric module is disposed over the base module and the sample is mounted on the thermoelectric module. In addition, claim 4 has been amended as set forth above to more particularly point out that the electrical connector (514) is disposed through a vacuum chamber wall (516) and into an interior vacuum section (518) of the FIB apparatus. Support for this amendment is found at least in Figures 5-7 and in paragraph [0035] of the specification.

“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). Moreover, “[t]he identical invention must be shown in as complete detail as is contained in the ... claim.” *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim, but this is not an *ipsissimis verbis* test, i.e., identity of terminology is not required. *In re Bond*, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990).

A review of the Richardson reference reveals that, contrary to the instant claims, the support block 51 (with thermal control means) is not disposed over the base member 52, but rather vice versa. Further, the three-dimensional part 19 (sample) is not mounted upon the support block 51 (i.e., thermoelectric module), but rather directly upon the base member 52. Therefore, because the elements disclosed in Richardson are not arranged as recited by independent claims 1 and 11, claims 1, 11, 13 and 18 cannot be anticipated by Richardson. Accordingly, Applicants traverse the §102(e) rejections thereto and respectfully submit that each claim dependent therefrom is also allowable.

As to the substantive §103 rejection of claim 4, the Applicants also respectfully traverse the same for the additional reason that Suzuki ‘626 does not in fact teach the additionally claimed element of electrically coupling a thermoelectric module to a current source through an electrical connector disposed through a vacuum chamber wall of an FIB tool and into an interior vacuum section 518 of the FIB tool. In the first place, Suzuki is directed to shielding radiation in a light detector/sensor assembly. (Col. 1, line 5- col. 2, line 21). As such, a skilled artisan has no motivation to combine cooling techniques of an FIB processing apparatus with cooling techniques associated with detecting devices as taught in Suzuki. Moreover, even if the teachings of Richardson and Suzuki were combined, Suzuki still fails to teach that the electrical connector (presumably “hermetically shielded lead wires 15” in Fig. 1 of Suzuki) is disposed

through a vacuum chamber wall of an FIB tool and into an interior vacuum section of the FIB tool.

Notwithstanding the fact that the Suzuki apparatus is not an FIB processing device, there is no teaching or suggestion in the reference that the “connector” 15 is disposed through a vacuum chamber wall and into an interior vacuum section. Although it is stated in Suzuki that the enclosed volume 16 is kept in a vacuum (col. 3, line 67), it is also seen from the cut-away view of the chamber 16 that connectors 15 themselves do not penetrate through the base plate 9 so as to be disposed though a vacuum chamber wall and into an interior vacuum section 16. In Suzuki, a “vacuum chamber wall” would necessarily constitute one of: the base plate 9, the enclosing case 13 or the light-transmissive window 14. Stated another way, since connectors 15 do not penetrate into vacuum section 16, Suzuki fails to provide each of the missing claimed elements of Richardson and the other cited references of record.

In contrast, claim 4 of the present disclosure recites a solution to conventional commercial FIBs that have previously failed to incorporate sample temperature control features. (Specification, paragraphs [0023], [0032]). Accordingly, for this additional reason, the §103 rejection of claim 4 is also traversed.

Therefore, it is respectfully submitted that each of the outstanding rejections of claims 1-19 have been overcome, and it is respectfully requested that the same be withdrawn.

For the above stated reasons, it is respectfully submitted that the present application is now in condition for allowance. No new matter has been entered and no additional fees are believed to be required. However, if any fees are due with respect to this Amendment, please charge them to Deposit Account No. 09-0458 maintained by Applicants' attorneys.

Respectfully submitted,
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